Stoller
Grand Junction Office established 1959

GJO-2004-551-TAC

299-E13-16 (A5861)
Log Data Report

Borehole Information:

Borehole: 299-E13-16 (A5861)			**Site:** 216-B-58 Trench		
Coordinates (WA State Plane)		**GWL (ft)[1]:** 349.2		**GWL Date:** 12/02/03	
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
134,347.24 m	573,182.69 m	Nov. 1956	228.775 m	369	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	2.4	4 1/2	4	1/4	+2.4	100.4
Welded steel	0	unknown	8	unknown	10.4	371.4
Steel	0	unknown	12	unknown	0	10.4
The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside 4-in. casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated. Casing depths are from Ledgerwood (1993). Only the 4-in. casing is visible at the ground surface.						

Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS[3], and Ledgerwood (1993). Zero reference is the top of the 4-in. casing. Crushed grout is present on the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1G		**Type:** 35% HPGe (34TP10967A)
Calibration Date:	4/2003	**Calibration Reference:**	GJO-2003-438-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	12/02/03	12/03/03	12/10/03	12/15/03	12/16/03
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	45.0	102.0	190.0	225.0	348.0
Finish Depth (ft)	3.0	44.0	101.0	189.0	280.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A[4]	N/A	N/A	N/A	N/A
Pre-Verification	AG026CAB	AG027CAB	AG031CAB	AG034CAB	AG035CAB

Log Run	1	2	3	4	5
Start File	AG026000	AG027000	AG031000	AG034000	AG035000
Finish File	AG026042	AG027058	AG031089	AG034036	AG035068
Post-Verification	AG026CAA	AG027CAA	AG031CAA	AG034CAA	AG035CAA
Depth Return Error (in.)	0	0	-2	-1	-1
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.

Log Run	6	7/Repeat	3		
Date	12/17/03	12/17/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	281.0	131.0			
Finish Depth (ft)	224.0	96.0			
Count Time (sec)	200	200			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AG036CAB	AG036CAB			
Start File	AG036000	AG036058			
Finish File	AG036057	AG036093			
Post-Verification	AG036CAA	AG036CAA			
Depth Return Error (in.)	N/A	-1			
Comments	No fine-gain adjustment.	Repeat section.			

Logging Operation Notes:

Zero reference was top of the 4-in. casing. Logging was performed without a centralizer installed on the sonde because a 4-in. liner was present. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118. During logging, fine-gain adjustments were not needed. Maximum logging depth achieved was 348 ft, approximately 1 ft above groundwater.

Analysis Notes:

Analyst:	Sobczyk	Date:	12/29/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 8.9 percent higher and 2.7 percent lower at the end of the day. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are accepted.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the SGLS data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G1GMay03.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 4-in. casing. On the basis of Ledgerwood (1993), the casing configuration was assumed to be a string of 8-in. casing from 10.4 ft to the maximum depth of the logging (348 ft), a string of 4-in. casing to 100.4 ft, and a string of 12-in. surface

casing to a depth of 10.4 ft. Casing correction factors were calculated assuming casing thicknesses of 1/4 in. for the 4-in. casing, 5/16 in. for the 8-in. casing, and 0.406 in. for the 12-in. casing. Because the 8-in. casing was not visible at the ground surface, the thickness for 8-in. casing was assumed to be 5/16 in., which was the measured thickness of 8-in. casings at nearby boreholes. The 12-in. casing was not visible at the ground surface, and the thickness for 12-in. casing was assumed to be 0.406 in., which is the thickness for schedule-40 casing. Where more than one casing exists at a depth, the casing correction is additive (e.g., 1/4 + 5/16 = 0.563 is the combined thickness for the 4-in. and 8-in. casings). No correction was applied for the screen (Ledgerwood 1993) between 303 and 367 ft. Water and dead time corrections were not required.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it is less affected by the presence of radon in the borehole.

Results and Interpretations:

^{137}Cs and ^{60}Co were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the interval from 6 to 11 ft with concentrations ranging from 0.4 to 2.0 pCi/g. The maximum concentration was detected at 9 ft. ^{137}Cs was also detected at 25, 101, 102, 146, 175, and 285 ft at concentrations near the MDL (0.2 pCi/g). ^{60}Co was detected in the interval from 104 to 111 ft and at 84 ft. The range of concentrations was from the MDL (0.1 pCi/g) to 0.4 pCi/g.

The presence of grout has affected the KUT response in this borehole. Grout is present in the annulus between the casings to a depth of 100 ft (Ledgerwood 1993). Grout is also present outside the 8-in. casing to a depth of at least 95 ft (Ledgerwood 1993).

The behavior of the naturally occurring ^{238}U log (measured by ^{214}Bi) suggests that radon may be present inside the borehole casing. Determination of ^{238}U is based on measurement of gamma activity at 609 and/or 1764 keV associated with ^{214}Bi, under the assumption of secular equilibrium in the decay chain. However, ^{214}Bi is also a short-term daughter of ^{222}Rn. When radon is present, ^{214}Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with ^{222}Rn. Radon daughters such as ^{214}Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with ^{214}Bi and ^{214}Pb. This phenomenon appears to best explain the observed discrepancy in ^{238}U values based on 609 keV between the original and repeat log runs, and the elevated gamma and ^{238}U values during log run 3 (190 to 101 ft).

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data. Taking into account the effects of radon, the plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides at energy levels of 1461 and 2614 keV and the man-made radionuclides (662, 1173, and 1333 keV). ^{137}Cs (based on 662 keV) was detected at 102 ft on the original log run while ^{137}Cs was not detected at 102 ft on the repeat log run. ^{60}Co (based on 1333 keV) was detected at 114 ft on the repeat log run while ^{60}Co was not detected at 114 ft on the original log run.

Gross gamma logs from Additon et al. (1977) (attached) indicate that the sediments surrounding this borehole contained man-made radionuclides between 1963 and 1976. Elevated gamma relative to background occurs in the intervals between 6 ft (2 m) and 23 ft (7 m) and from 43 ft (13 m) through 59 ft (18 m) from 1963 through 1976. The log from 5/26/59 appears to detect only background levels of gamma radiation. The SGLS detected only minor amounts of ^{137}Cs in the interval between 6 and 11 ft and trace amounts of ^{60}Co in the interval from 104 to 111 ft.

References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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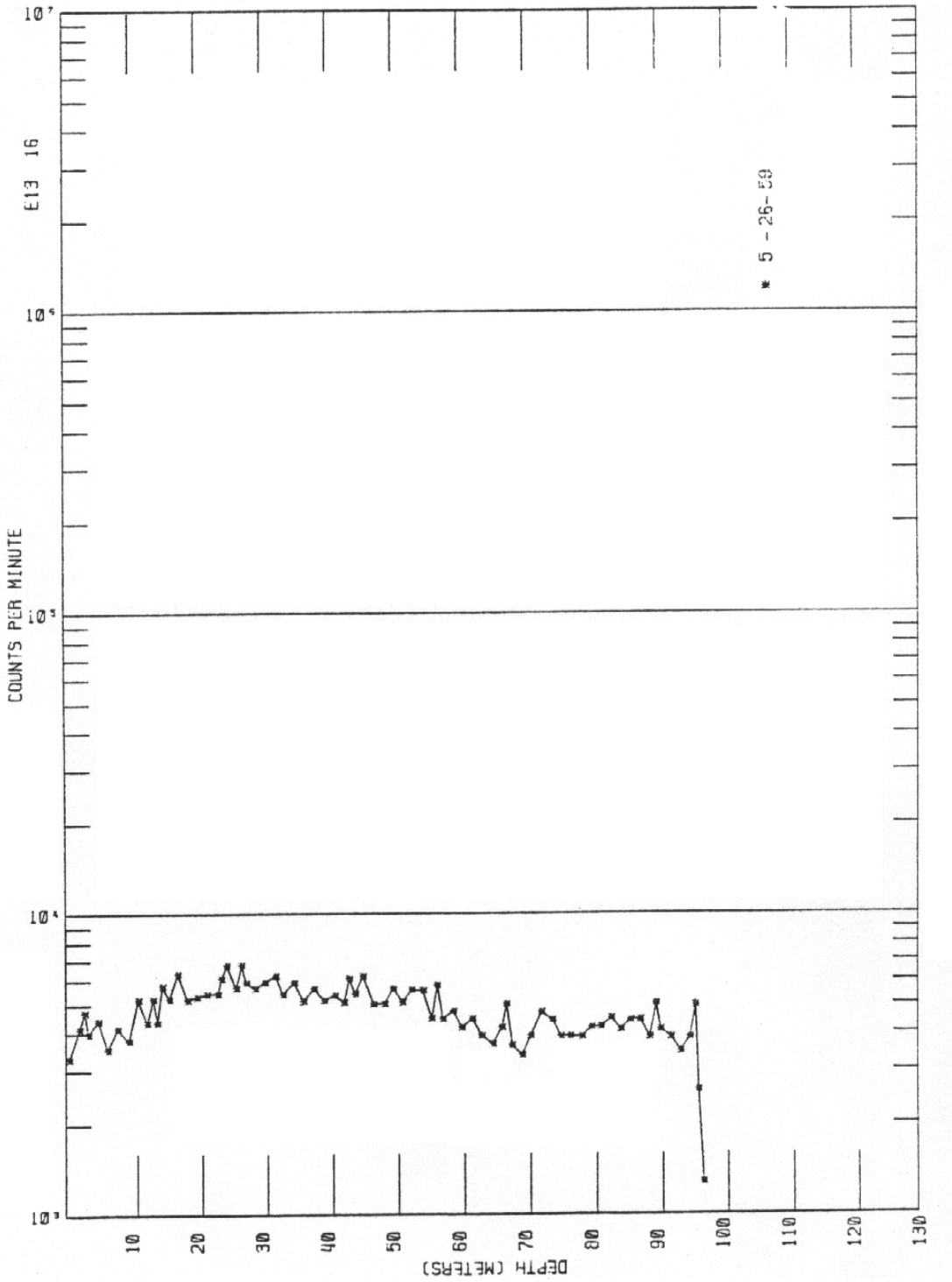
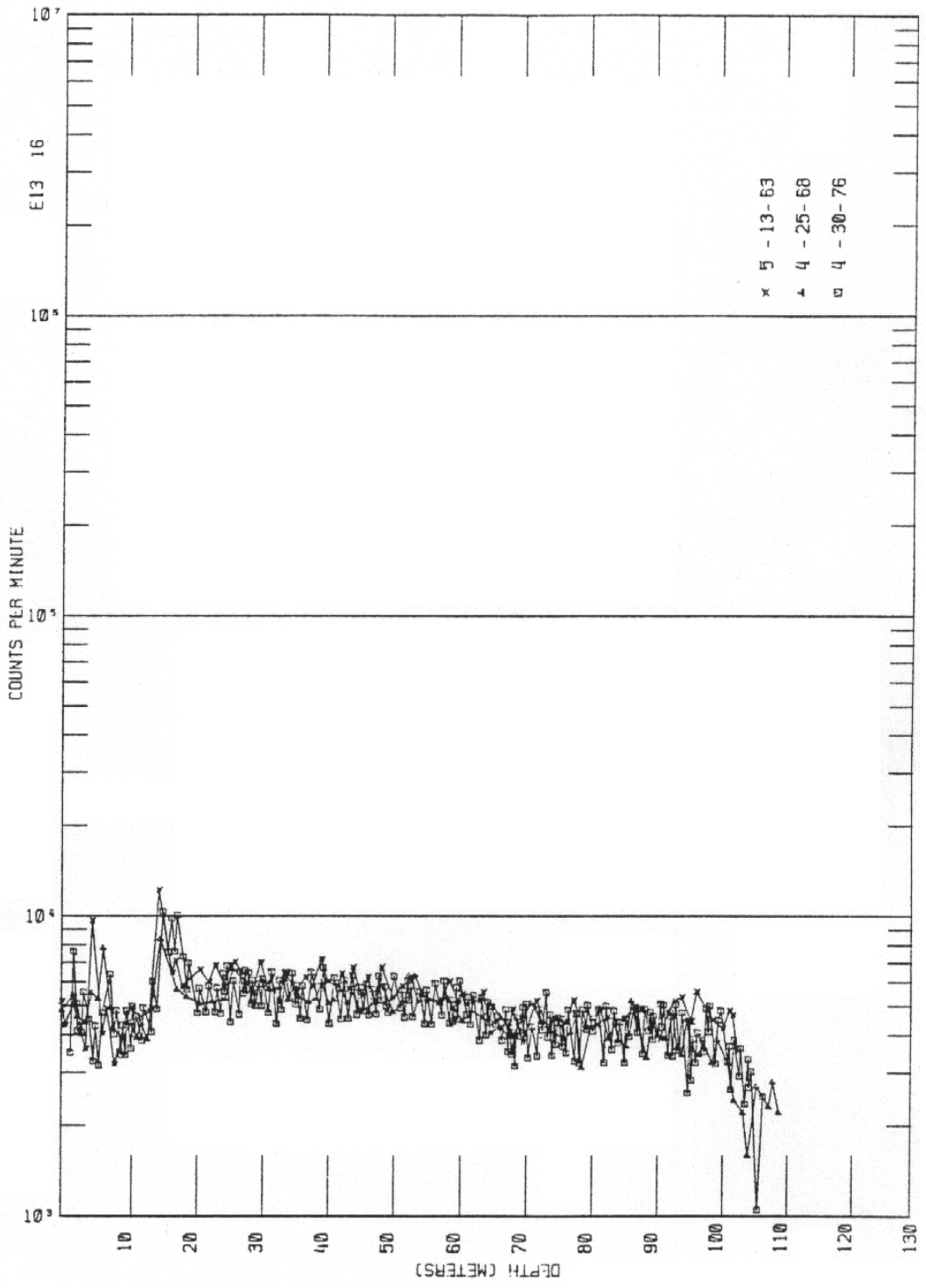
[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable



from Additon et al. (1978)

Scintillation Probe Profile for Borehole 299-E13-16, Logged on 5/26/59

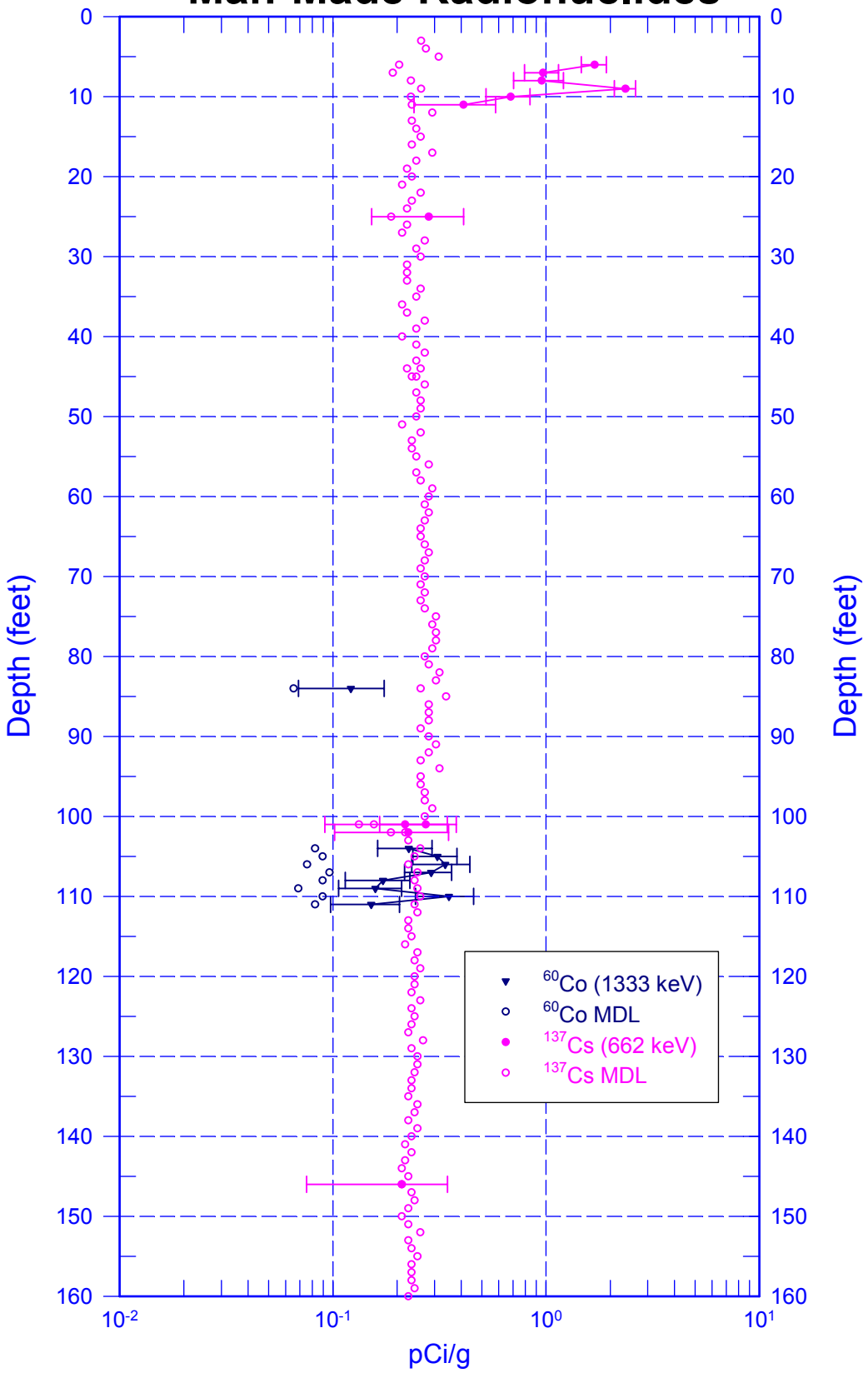


from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E13-16, Logged on 5/13/63, 4/25/68, and 4/30/76

299-E13-16 (A5861)

Man-Made Radionuclides

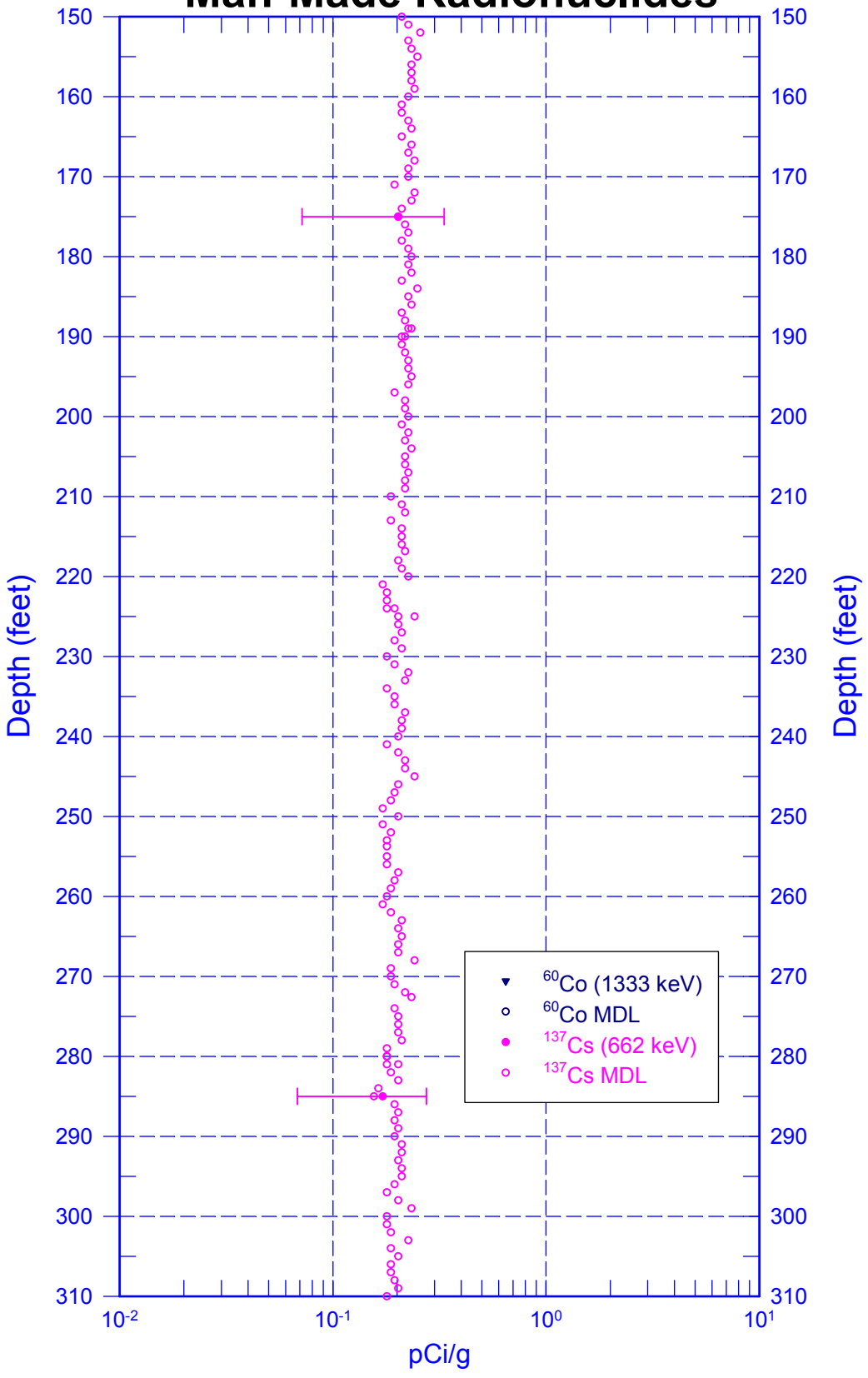


Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
12/17/2003

299-E13-16 (A5861)

Man-Made Radionuclides

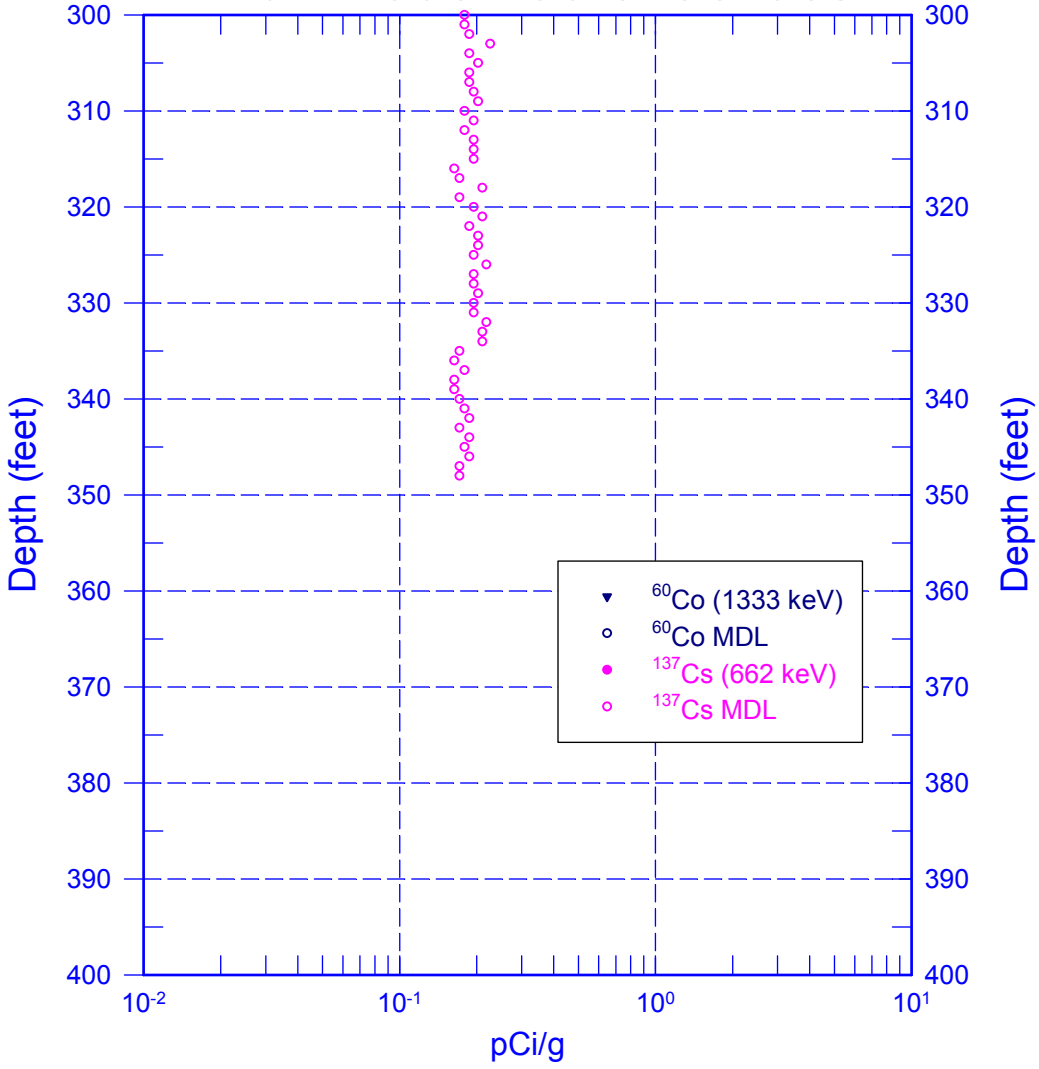


Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
12/17/2003

299-E13-16 (A5861)

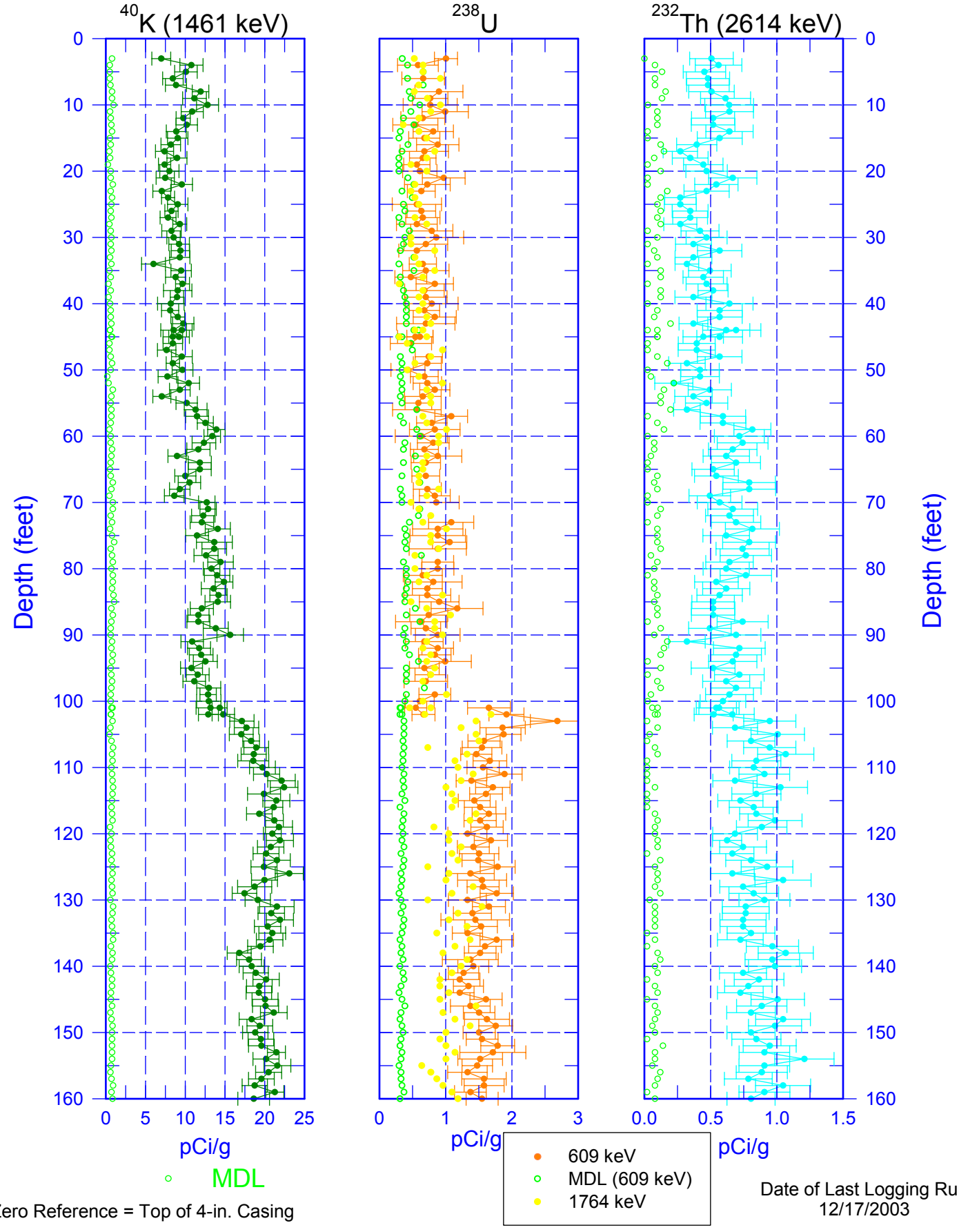
Man-Made Radionuclides



Zero Reference = Top of 4-in. Casing

Date of Last Logging Run
12/17/2003

299-E13-16 (A5861)
Natural Gamma Logs



Zero Reference = Top of 4-in. Casing

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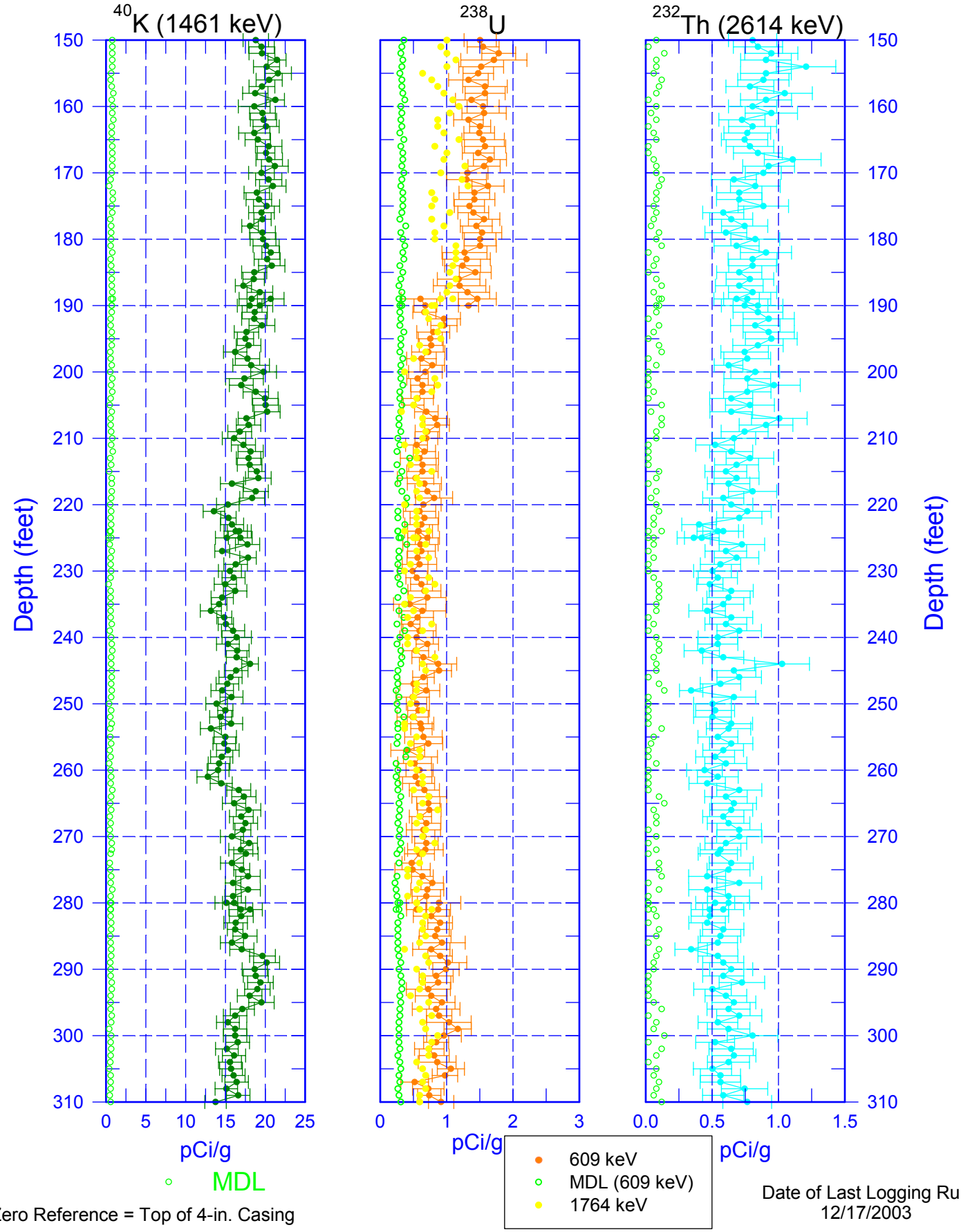
299-E13-16 (A5861)
Natural Gamma Logs



Zero Reference = Top of 4-in. Casing

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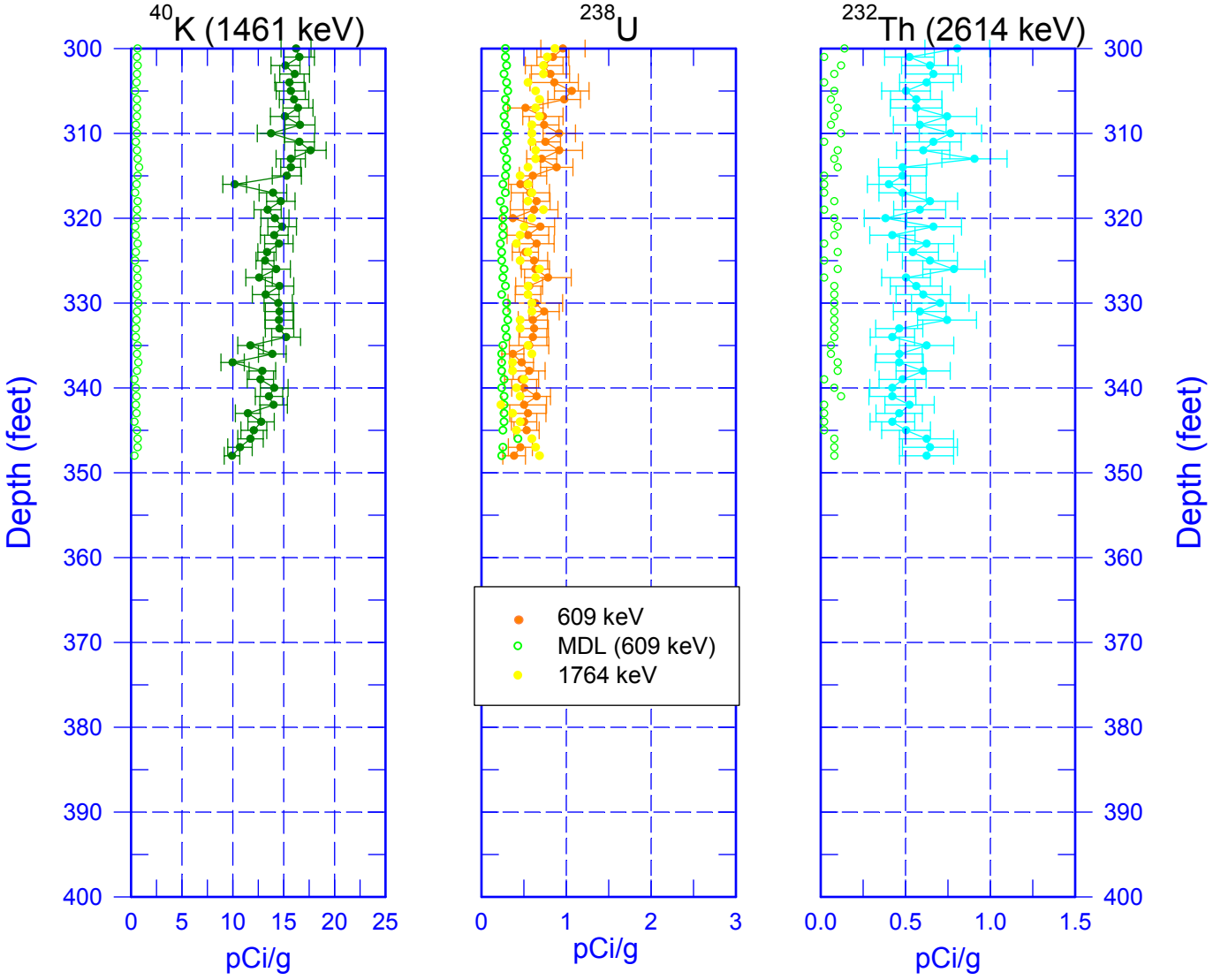
12/17/2003

299-E13-16 (A5861)
Natural Gamma Logs

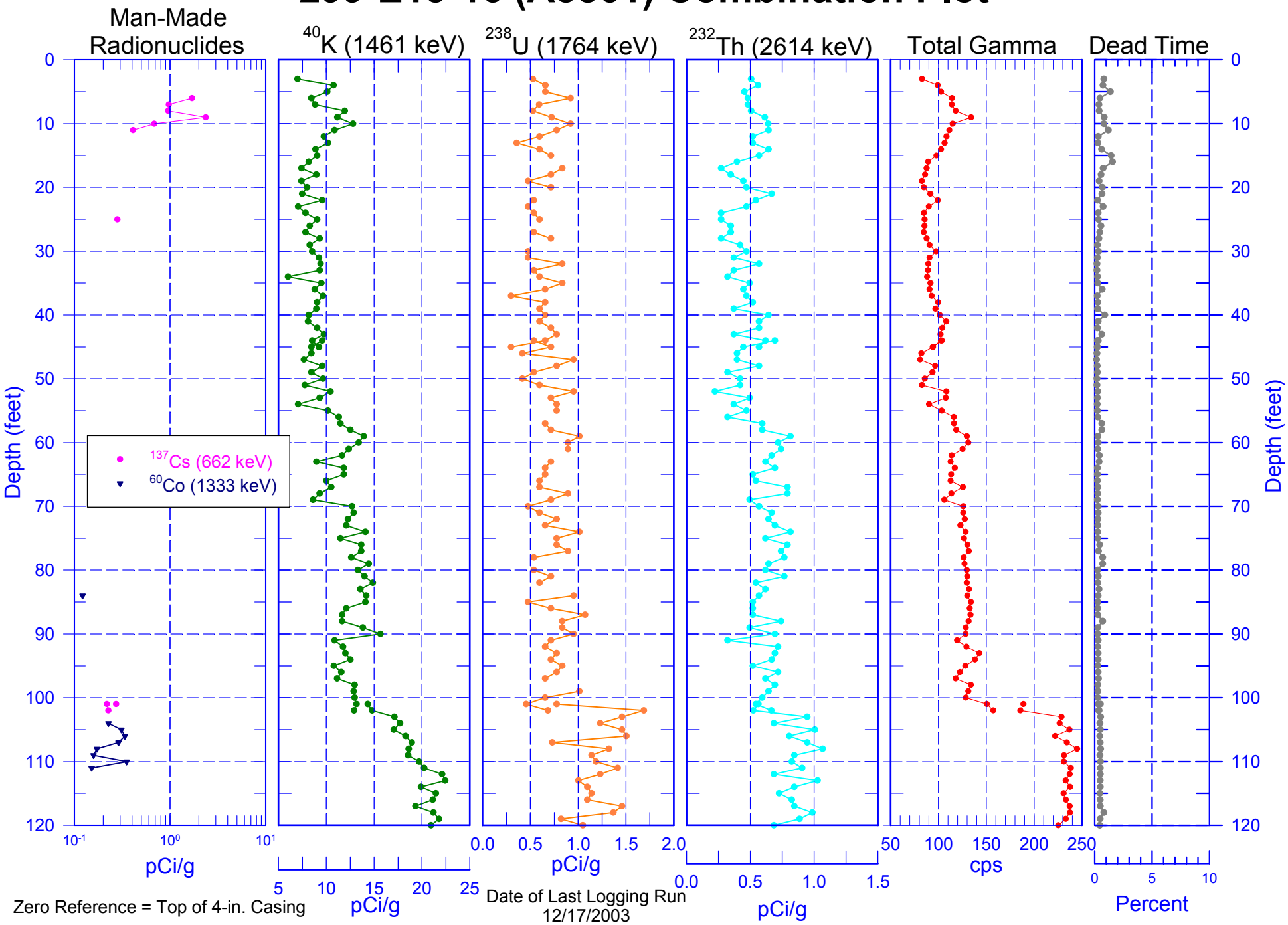


Zero Reference = Top of 4-in. Casing

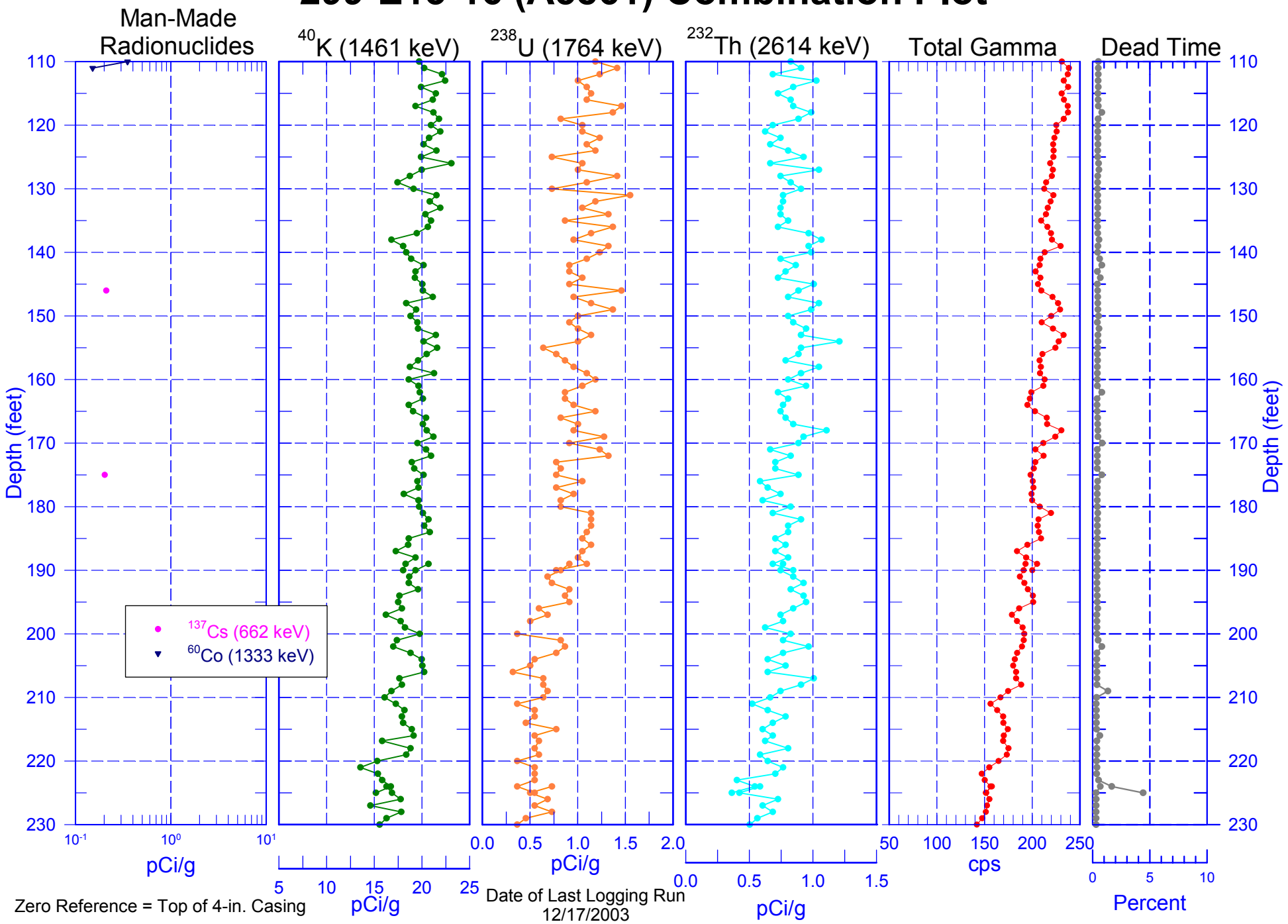
MDL

Date of Last Logging Run
12/17/2003

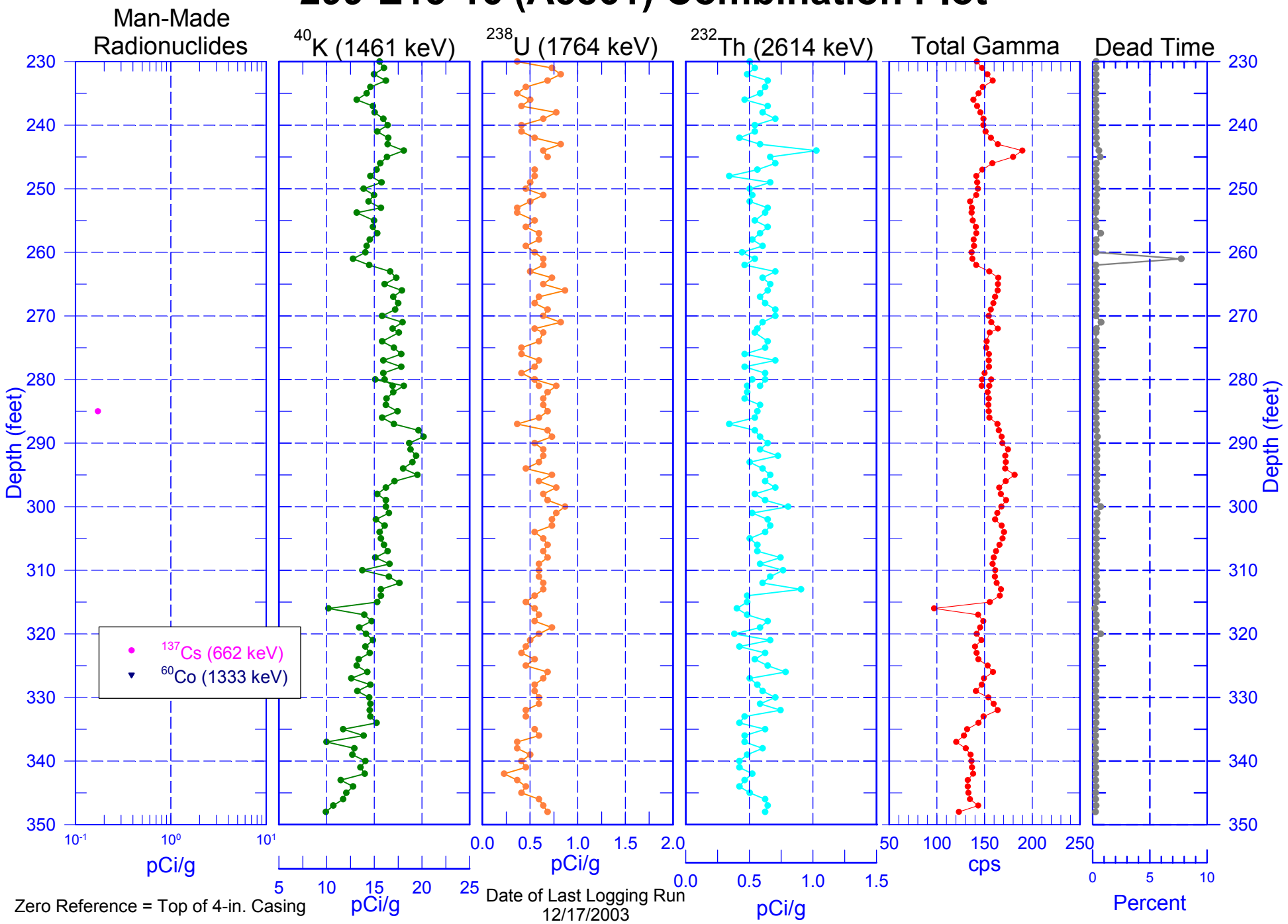
299-E13-16 (A5861) Combination Plot



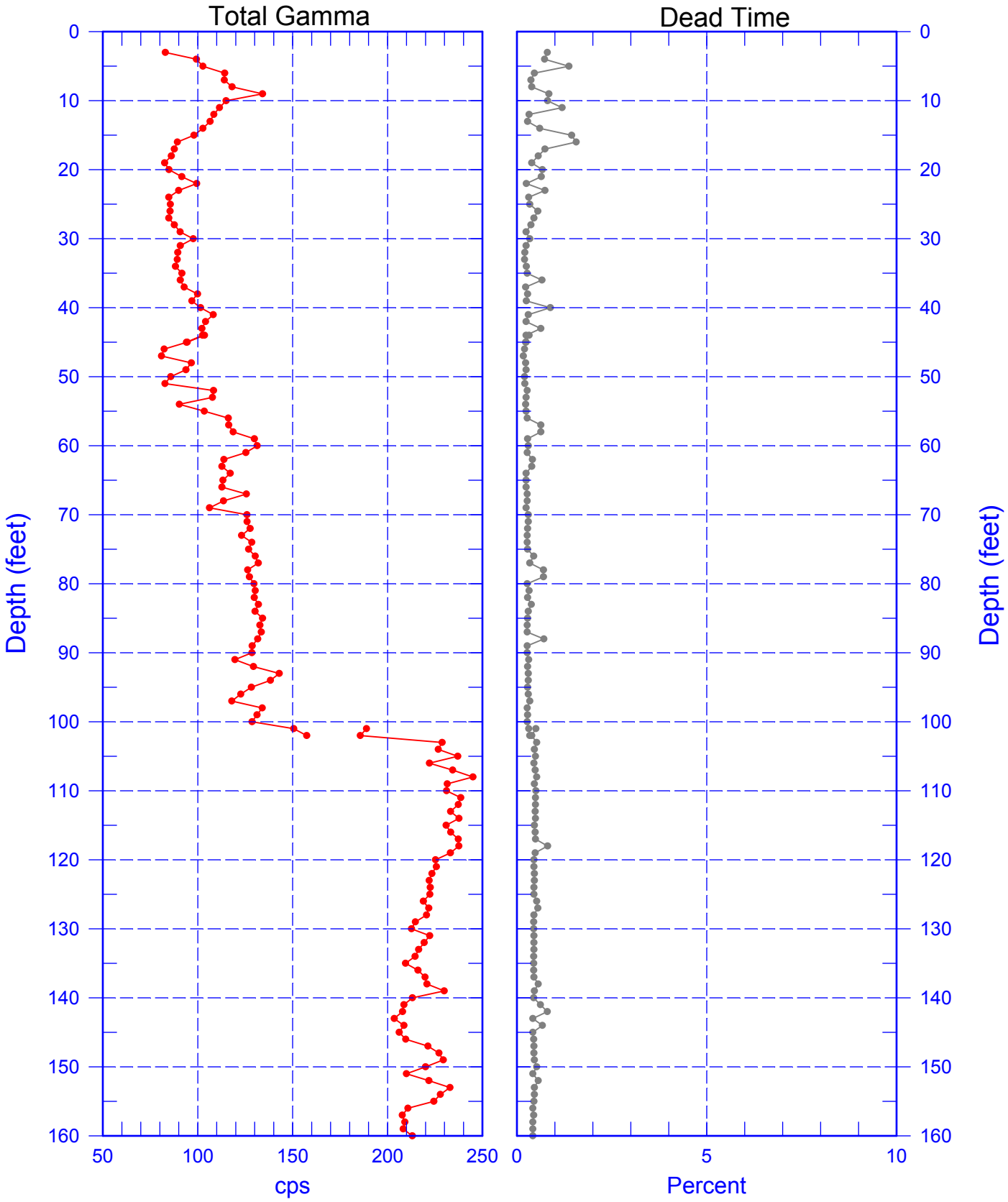
299-E13-16 (A5861) Combination Plot



299-E13-16 (A5861) Combination Plot

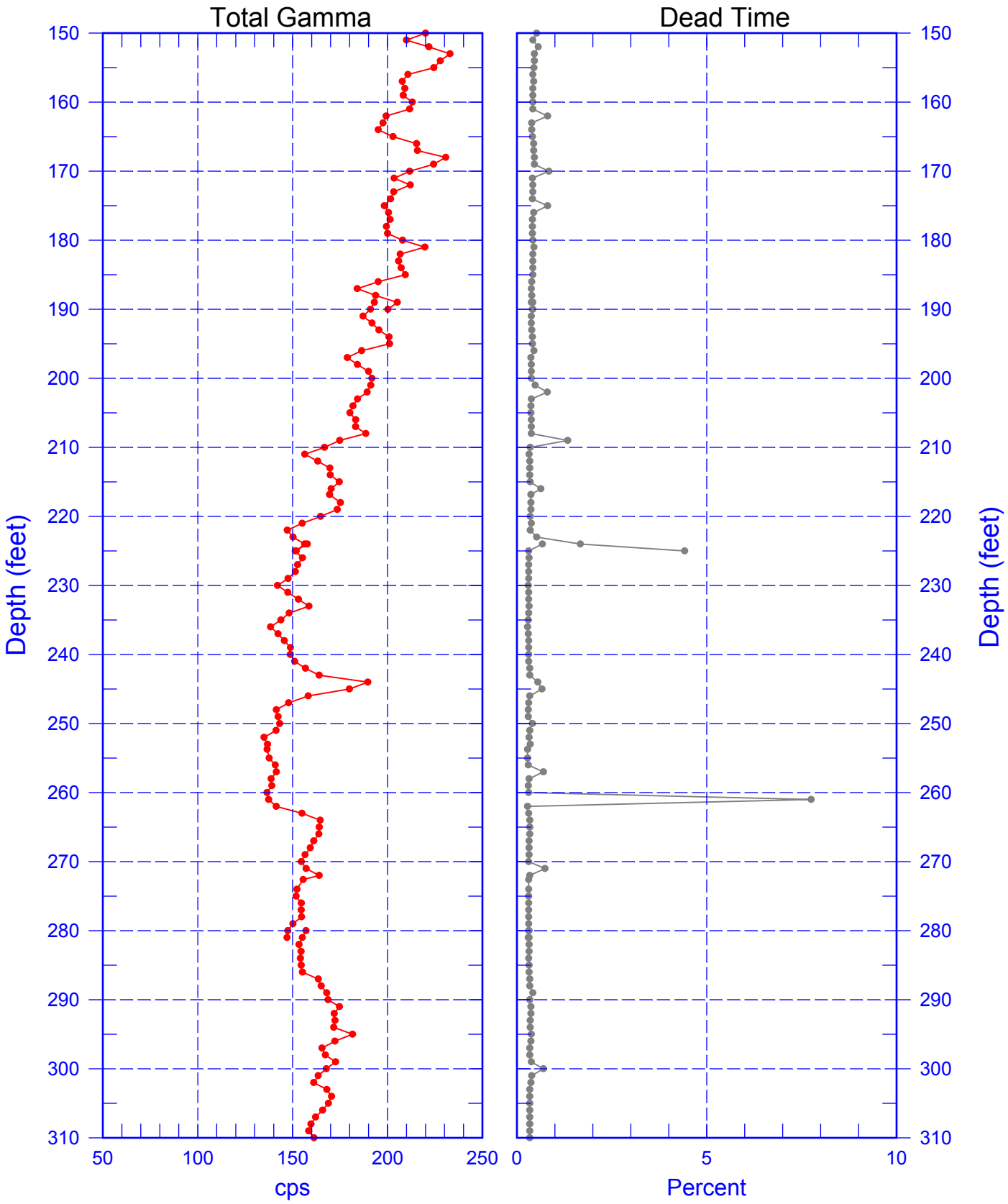


299-E13-16 (A5861)
Total Gamma & Dead Time



Zero Reference = Top of 4-in. Casing
Date of Last Logging Run
12/17/2003

299-E13-16 (A5861)
Total Gamma & Dead Time



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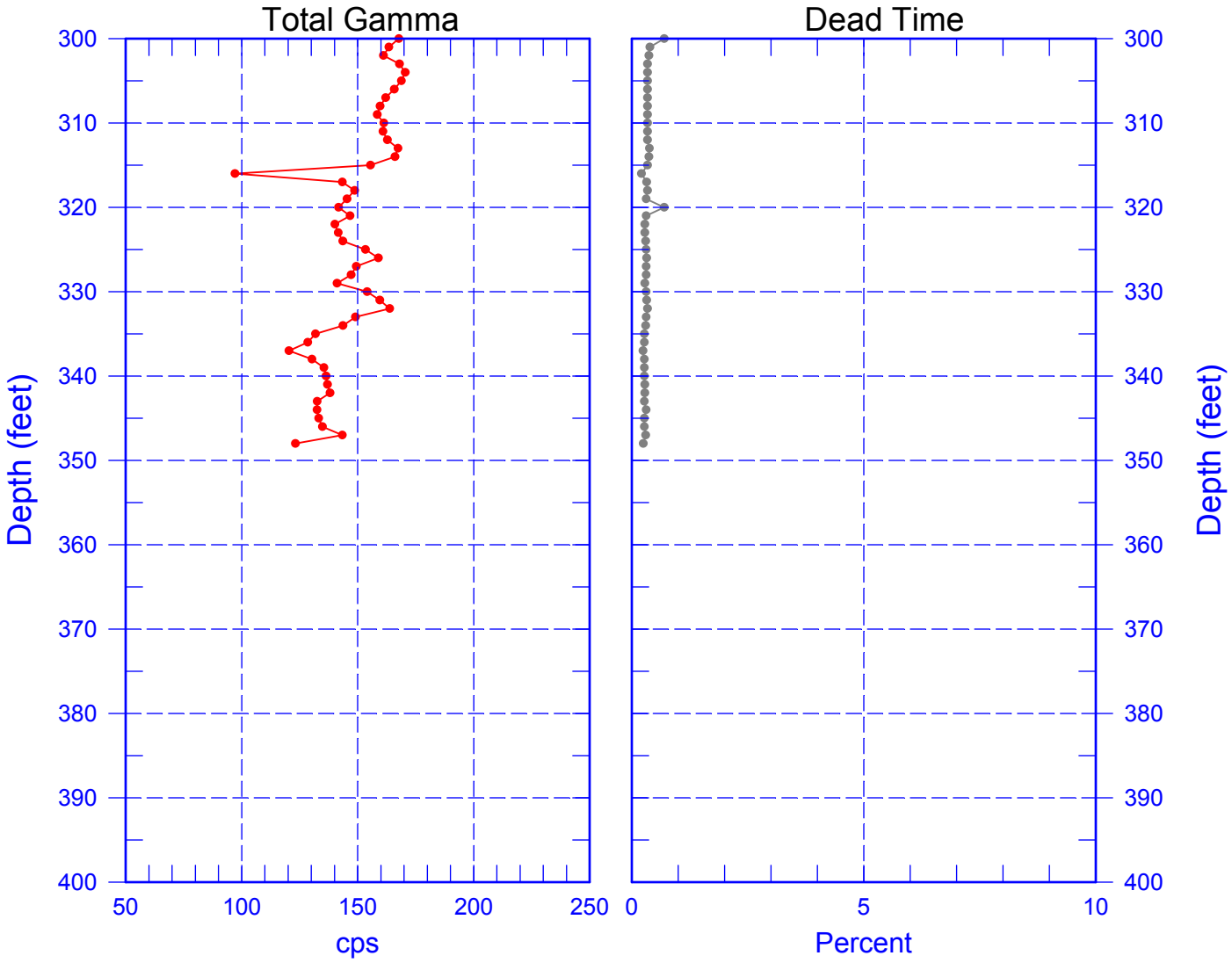
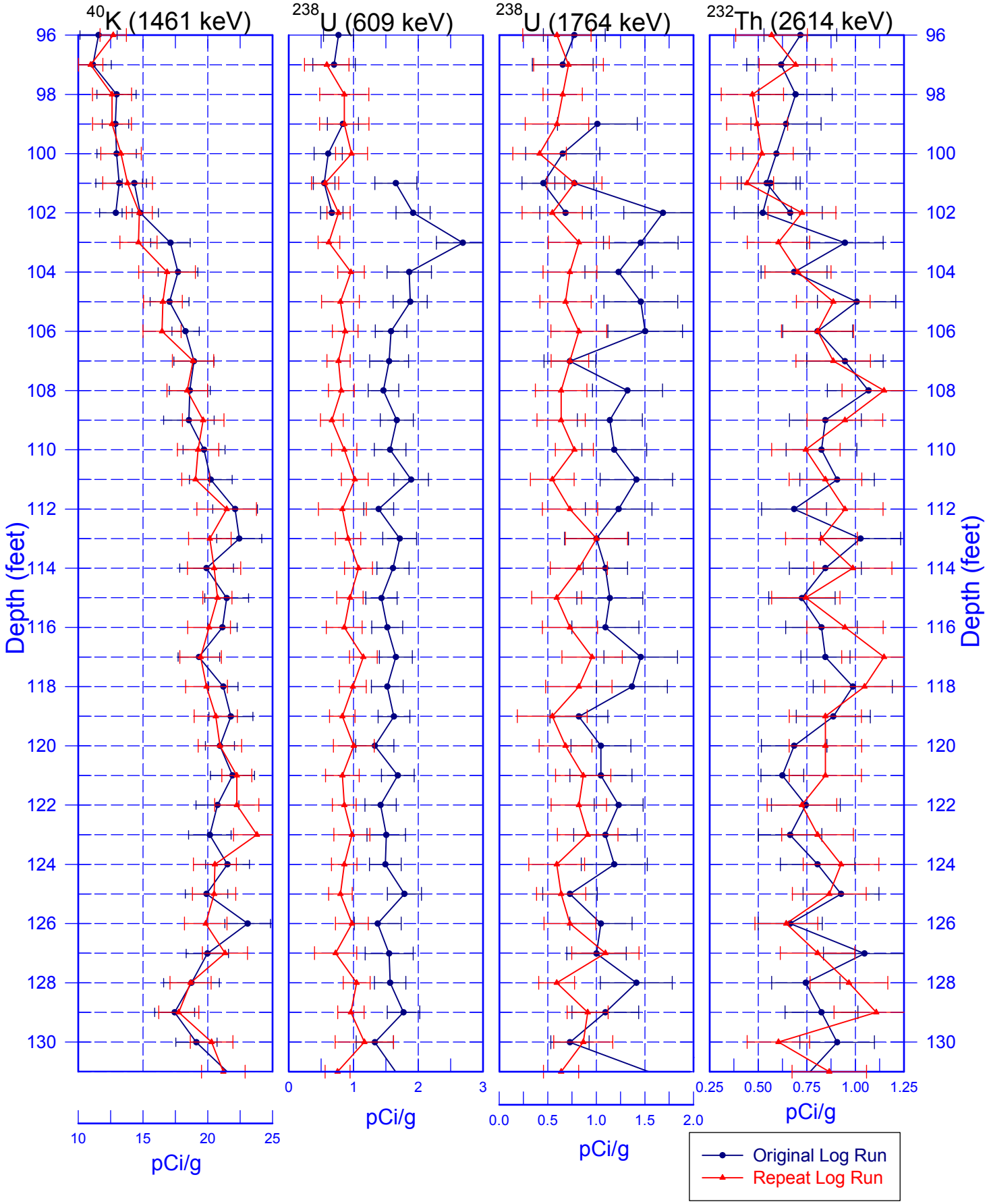
Total Gamma & Dead Time



Zero Reference = Top of 4-in. Casing
Date of Last Logging Run
12/17/2003

299-E13-16 (A5861)

Rerun of Natural Gamma Logs (131.0 to 96.0 ft)



299-E13-16 (A5861)

Rerun of Man-Made Radionuclides (131.0 to 96.0 ft)